Temperature-induced valence transition of $EuNi_2(Si_{0.25}Ge_{0.75})_2$ studied by high-resolution 4*d*-4*f* resonant photoemission

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Introduction

$EuNi_2(Si_{0.25}Ge_{0.75})_2$ is a material with temperature-induced valence transition [1]. To investigate of the origin of the valence transition, we have measured both of Eu 4d-4f and Eu 3d-4f resonant photoemission spectra. In this paper, the results of the Eu 4d-4f resonant photoemission experiment that was done at BL11D and BL18A are reported.

Results and discussion

Figure 1 indicates the temperature dependence of the difference spectrum of the off-resonance spectrum from the on-resonance at the Eu 4*d*-4*f* absorption edge. The main peak at the binding energy of 1.8 eV and the shoulder structure at 0.8 eV originate from the surface and the bulk component of Eu^{2+} $4f^{6}$ final state, respectively. The intensity of the shoulder structure does not change drastically across the valence transition temperature of 110 K. The result indicates the mean valence of the bulk component does not change largely, i.e., 2.1 at high temperature and 2.3 at low temperature.

The mean valence at low temperature has been evaluated by the absorption at the Eu L_{III}-edge, the Eu 3*d*-4*f* resonant photoemission, the Eu 3*d* XPS and the absorption at the Eu $M_{IV,V}$-edge [2]. The mean valence at low temperatures is much different from each other, i.e., 2.85 by the L_{III}-absorption edge and 2.3 by the other experiments. The present result of the Eu 4*d*-4*f* resonant photoemission is consistent with the later experiments.

The Ni 3*d* state which makes the valence band of this material slightly shifts to the high binding energy side with increasing temperature, i.e., the valence of Ni decreases with decreasing the valence of Eu. This suggests the electronic states of Si and Ge strongly relate to the valence transition of this material.

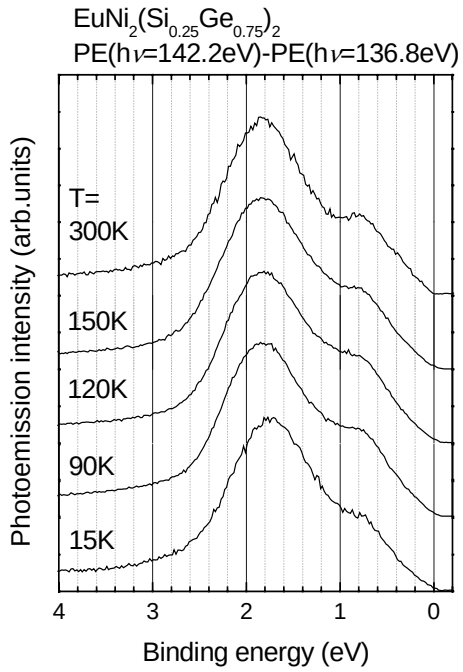

Fig.1. Temperature dependence of the difference spectrum between on- and off-resonance photoemission of $EuNi_2(Si_{0.25}Ge_{0.75})_2$ at the 4d-4f absorption edge.

References

[1] H. Wada *et al.*, J. Phys. Condens. Matter **9** (1997) 7913.

[2] H. P. N. J. Gunasekara *et al.*, UVSOR Activity Report 1997 (1998) 144; T. Kinoshita *et al.*, in preparation.

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